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RESEARCH SUMMARY

forest sciences
NELSON FOREST REGION

October 1995 RS-022

Effects of *Armillaria* Root Disease on Forest Ecosystems

■ ***Armillaria* root disease has significant implications for various forest ecosystem components**

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INTRODUCTION

Armillaria species are found throughout most of British Columbia. *Armillaria ostoyae*, the most pathogenic of the six species found in the province, occurs in most biogeoclimatic zones throughout the southern third of British Columbia. Despite the widespread occurrence of *Armillaria ostoyae*, and its persistence in forested ecosystems, the role it plays in ecosystem functioning is poorly understood. Much of the research to date has either focused on species identification, or on disease dynamics in relation to the timber resource. Few studies have considered its relationship to other ecosystem components, or its significance in ecosystem functions.

THE ROLE OF *ARMILLARIA*

Anecdotal observations, and past and present research, suggest that species of *Armillaria* fungi are intricately linked to a number of ecosystem processes. The fungi play a role in decomposition and nutrient cycling. They also appear to cause successional changes, and predispose hosts to secondary damaging agents. The presence of *Armillaria* root disease has significant implications for many forest ecosystem components, including wildlife, biodiversity, site productivity and social values. The distribution of impacts range from favourable to detrimental, depending on the organisms and ecological processes involved.

Decomposition and nutrient cycling

The saprophytic phase of *Armillaria ostoyae* decays the root system and lower bole of infected trees once they die, releasing bound nutrients. Though this role is significant, there are many other species of saprophytic fungi in forest ecosystems that also perform this role. The primary importance of the saprophytic phase of *Armillaria ostoyae* is that it allows the fungus to persist on a site in the absence of living hosts, until new suscepts have regenerated. At this time, the fungus can act parasitically to colonize new hosts.

Successional changes

Armillaria ostoyae affects the progression of natural succession by killing susceptible host plants. This reduces competition and releases nutrients, providing opportunities for other plants to grow (2) and changing the species composition of the forest.

The effect of *Armillaria* root disease on succession and stand development is not consistent from site to site. *Armillaria ostoyae* has been described as both increasing the rate of natural succession (4), and slowing or reversing successional changes (8). In the ICH biogeoclimatic zone, early and mid-seral species such as Douglas-fir and lodgepole pine appear to be most susceptible to *Armillaria* root disease and will often die out of a heavily infected stand. This changes the species composition of the stand to a mix more typical of later seral or climax stands (i.e., predominantly western redcedar and western hemlock). On severely infected sites, the majority of conifers die out, creating canopy openings suitable for invasion by pioneer species.

Secondary damaging agents

The connection between *Armillaria* root disease, and secondary damaging agents, such as insects, other diseases, windthrow, and fire, has been recognized but is poorly understood. *Armillaria ostoyae* is often a primary pathogen that weakens trees, eventually killing them. The reduced vigour of infected trees may render them more susceptible to other damaging agents, such as bark beetles. Insects and other damaging agents may be the apparent cause of mortality; however, the underlying factor

may be root disease. *Armillaria ostoyae* may also act as a secondary rather than primary damaging agent. Stressed trees are killed more quickly than healthy ones because they cannot resist the disease as successfully.

Wildlife

Armillaria root disease provides dead, dying, and decayed trees for use by wildlife species. There are more than 90 indigenous wildlife species in British Columbia that are critically dependent on snags for feeding, reproduction, or shelter (5). Many of these species raise their young in dead tree cavities that are either created naturally (breaking of a limb, peeling bark, heartrot, etc.) or excavated by woodpeckers. Live, healthy trees are not suitable for these species because they are unlikely to develop natural cavities and are not soft enough for most woodpeckers to excavate.

Steeger and Machmer (5) found that 62% of 111 active nests used by primary cavity nesters in selected stands of the ICHdw biogeoclimatic subzone were located within or on the periphery of *Armillaria* root disease centers. Woodpecker feeding intensity was also higher in plots that showed signs and symptoms of *Armillaria* root disease infection. This may be explained by an association between *Armillaria* root disease and mountain pine beetle (6,7), a major prey of woodpecker populations in the study area. However, *Armillaria* may be detrimental to animals dependent on highly susceptible plants.

Wildlife may also benefit from the canopy gaps created by *Armillaria* root disease induced mortality. These gaps are often invaded by hardwoods such as birch and aspen, and these areas are of high habitat value to a number of wildlife species (1).

Biodiversity

Armillaria root disease causes mortality in highly susceptible tree and shrub species and this can have long-term implications for forest biodiversity at all levels. At the genetic level, *Armillaria* root disease may influence the survival of host trees due to differing levels of genetically based tolerance between tree species. At the tree species level, *Armillaria ostoyae* has the potential to alter species composition within a stand, which in turn will influence plant and associated animal community structure.

Armillaria ostoyae-caused mortality increases spatial heterogeneity and the availability of certain habitat elements that are important for biodiversity within forest stands (e.g., snags, fallen logs, coarse woody debris, deciduous patches). This increased structural diversity may provide a greater range of micro- and macro-habitat types for forest-dwelling plants and animals.

Timber productivity

Little research has been done on the effects of *Armillaria* root disease on the productivity of older second-growth stands. Woods (8) reported that timber volumes currently harvested from the ICH biogeoclimatic zone would probably not be supported in the future if current forest management strategies such as brushing, juvenile spacing, and partial cutting continue. The long-term productivity of stands that were selectively logged in the past is also questionable since these stands are often heavily infected with *Armillaria ostoyae*.

Social values

Armillaria root disease can have a significant impact on various social values, including recreation and visual landscape quality. Root systems of infected trees can be structurally compromised by *Armillaria* root disease, causing blowdown in heavily infected stands. This may create a safety risk in areas used extensively for recreation. Root disease may improve visual landscape quality by increasing diversity (both colour and texture) in homogeneous stands.

SUMMARY

The dynamics and role of *Armillaria* root disease in forested ecosystems is poorly understood. Researchers now recognize that *Armillaria* root disease has important implications for many forest components and that research efforts must attempt to address these issues.

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